

DIVISION 500 - RIGID PAVEMENT

SECTION 501 - PORTLAND CEMENT CONCRETE PAVEMENT

501.01--Description. This work consists of pavement composed of portland cement concrete, with or without reinforcement as specified, constructed in accordance with these specifications and in reasonably close conformity with the lines, grades, thicknesses, and cross sections shown on the plans or established by the Engineer. This work also consist of replacing or repairing damaged or deteriorated dowels and wooden joint filler boards.

501.02--Materials. Materials shall meet the applicable requirements of Division 700 and the following Subsections:

Fine Aggregate	703.01 and 703.02
Coarse Aggregate	703.01 and 703.03
Portland Cement	701.01 and 701.02
Water	714.01
Air Entraining Admixtures & Additives	713.02
Calcium Chloride	714.02
Joint Filler	707.02
Curing Materials	713.01
Reinforcing Steel and Dowel Bars	711.02
Dowel Adhesive	714.11

501.02.1--Composition of Concrete.

501.02.1.1--General. The concrete mix design shall be submitted by the Contractor to the Engineer for approval prior to production. The mix proportions shall be based on a laboratory batch as described below.

- a) The combination of materials shall be those intended for use in the proposed work. Materials shall be from approved sources. Aggregate gradations, specific gravities and bulk densities shall be reported.
- b) Trial mixtures having proportions and consistencies suitable for the proposed work shall be made using the ACI 211.1 as a guide to proportion the mix design.
- c) Trial mixtures shall be designed to produce a slump within $\pm 3/4$ in. of the maximum permitted, and for air-entrained concrete, 6.0 ± 0.5 percent total air content. The temperature of freshly mixed concrete in trial mixtures shall be reported.
- d) For each proposed mixture, at least three compressive test cylinders shall be made and cured in accordance with AASHTO Designation: T 126.

Each change of water-cement ratio shall be considered a new mixture. The cylinders shall be tested for strength in accordance with AASHTO Designation: T 22 and shall meet the required 28 day strength.

- e) The strength of laboratory trial mixes shall exceed 4700 psi.
- f) The laboratory trial batch mixtures shall have been made within the last three months before being submitted for approval.

501.02.1.2--Design of Mix. The mix shall be designed to meet the requirements as set out in the following table.

Design Property	Requirements
Minimum Coarse Aggregate Volume / cubic yard Concrete, %	72
Coarse Aggregate Size	467 or 57
Maximum Water / Cementitious Ratio	0.48
Maximum Slump, inches	3
Total Air Content, %	3 - 6
Minimum Compressive Strength, psi	3500

501.03--Construction Requirements.

501.03.1--Batching Plant and Equipment. Concrete batching and handling equipment shall meet the applicable requirements of AASHTO Designation: M 157.

501.03.2--Blank.

501.03.3--Blank.

501.03.4--Blank.

501.03.5--Placing, Spreading, and Finishing Equipment.

501.03.5.1--Finishing Machine. The finishing machine shall be equipped with at least two oscillating type reverse screeds.

501.03.5.2--Vibrators. Vibrators, for full width vibration, may be the surface pan type or the internal type with either immersed tube or multiple spuds. They may be attached to the spreader, paver, or the finishing machine, or may be mounted on a separate carriage. They shall not come in contact with the joint, reinforcing steel, load transfer devices, subgrade, or side forms. The frequency

of the surface vibrators shall be at least 3,500 impulses per minute, and the frequency of the internal type shall be at least 5,000 impulses per minute for tube vibrators and at least 7,000 impulses per minute for spud vibrators.

When spud type internal vibrators, either hand operated or attached to spreaders or finishing machines, are used adjacent to forms, they shall have a frequency of not less than 3,500 impulses per minute.

501.03.5.3--Slip-Form Paver. Slip-form pavers shall be self-propelled and equipped to spread, strike-off, consolidate, screed, and float-finish the freshly placed concrete so that a minimum of hand-finishing will be necessary. The equipment shall be adjustable as to crown and superelevation, and shall shape and compact the concrete into the required cross section. The crown adjustment shall be readily controllable for accuracy in crown transitions.

The paver shall operate on tracks having sufficient contact area to prevent slippage under load. The length of ground contact per track and the arrangement of tracks shall be adequate to meet the straightedge and other riding quality requirements specified.

Screeding shall be accomplished by using either oscillating screeds or an extrusion device, or a combination thereof.

The slip-form paver shall be equipped with traveling side or trailing forms, of sufficient dimension and strength and of proper shape, to support the concrete laterally for a sufficient length of time during placing and finishing. If trailing forms are used they shall be rigidly supported laterally.

The slip-form paver shall be equipped with automatic guidance and grade controls, which operate by sensing from a taut line set to line and grade.

Variation from the requirements detailed herein may be permitted when approved by the Department, provided the proposed variation is an improved feature for which general acceptance by the industry has been established.

501.03.5.4--Steel Placing Equipment. Equipment, as approved by the Engineer, for machine placement of reinforcement shall be factory made by a recognized manufacturer of construction equipment and shall be capable of positioning the steel at the designated location.

501.03.5.5--Transverse Texturing Device. Transverse texturing shall be produced by either tining or grooving as indicated in the plans or in the contract documents.

Other types of texturing equipment may be approved by the Department provided it produces a texture equivalent to that specified.

501.03.5.5.1--Transverse Tining. This equipment shall be a metal tine finishing device having flat steel wire tines capable of being operated to produce uniform, parallel grooves in newly placed pavement.

501.03.5.5.2--Transverse Grooving. This equipment shall be a self-propelled mechanical sawing device using diamond blades. The blades shall be arranged in such a manner to produce grooves 1/8" wide and 3/16" deep spaced in the following sequence: 3/4-inch, 1 1/8-inch, 5/8-inch, 1-inch, 5/8-inch, 1 1/8 -inch, 3/4-inch in six-inch repetitions across the width of the sawing device.

501.03.6--Miscellaneous Equipment.

501.03.6.1--Concrete Saw. When sawing joints is elected or specified, the Contractor shall provide sawing equipment adequate in number of units and power to complete the sawing to the required dimensions using a water-cooled diamond edge saw blade, abrasive wheel, "early entry dry cut" type blade, or other device approved by the Engineer.

501.03.6.2--Forms. Straight side forms shall be metal and have a thickness of at least 7/32 inch and shall be furnished in sections at least 10 feet in length. Forms shall have a depth equal to the specified edge thickness of the pavement and a base width of at least 80 percent of the depth of the forms. Flexible or curved forms of proper radius shall be used for curves of 100-foot radius or less. Flexible or curved forms shall be of a design acceptable to the Engineer. Forms shall be provided with adequate devices for secure setting so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Flange braces shall extend outward on the base not less than 2/3 the height of the form. Forms with battered top surfaces, and bent, twisted, or broken forms shall be removed from the work. Repaired forms shall not be used until inspected and approved. Forms shall not be built-up more than one inch. The top face of the form shall not vary from a true plane more than 1/8 inch in 10 feet, and the upstanding leg shall not vary from a vertical plane more than 1/4 inch. The forms shall contain provisions for secure setting and for locking the ends of abutting form sections together tightly.

501.03.7--Preparation of Grade. The foundation upon which the concrete pavement is to be placed shall be prepared within the tolerances set out in Subsection 321.03 for at least two feet beyond the proposed pavement edge.

501.03.8--Setting Forms.

501.03.8.1--Base Support. The foundation under the forms shall be hard and true to grade so that the form, when set, will be firmly in contact for its whole length and at the specified grade. A grade at the form line which is found to be below the established grade shall be filled to grade with granular materials or bituminous plant mixture in lifts of 1/2 inch or less for the full width of the base

of the form and at least 18 inches outside the base of the form, and thoroughly compacted. Imperfections or variations above grade shall be corrected by tamping or by cutting as necessary.

501.03.8.2--Form Setting. Forms shall be set sufficiently in advance of where concrete is being placed. After the forms have been set to correct grade, the grade shall be thoroughly tamped, mechanically or by hand, at both the inside and outside edges of the base of the forms. Forms shall be staked into place with at least three pins for each 10-foot section. A pin shall be placed at each side of every joint. Form sections shall be tightly locked and free from play or movement in any direction. The forms shall not deviate from true line by more than 1/4 inch at any point. Excessive settlement or springing of forms under the finishing machine will not be tolerated. Forms shall be cleaned and oiled prior to the placing of concrete.

501.03.8.3--Grade and Alignment. The alignment and grade of the forms shall be checked and corrections made by the Contractor immediately before placing the concrete. When a form has been disturbed or a grade has become unstable, the form shall be reset and rechecked.

501.03.9--Conditioning of Base.

501.03.9.1--Conditioning for Formed Pavement. High areas shall be trimmed to proper elevation. Low areas, within the tolerances set out in Subsection 321.03.7 shall be filled with concrete integral with the pavement. The finished grade of the base shall be maintained in a smooth and compacted condition until the pavement is placed.

Unless the base course is waterproof, it shall be uniformly moist when the concrete is placed.

501.03.9.2--Conditioning for Slip-Form Pavement. The base shall be brought to the tolerances set out in Subsection 321.03.7. If the density of the base is disturbed, it shall be corrected by additional compaction before concrete is placed. The grade shall be prepared sufficiently in advance of the placing of the concrete to avoid delays. If traffic is allowed to use the prepared grade, the grade shall be checked and corrected immediately ahead of the placing of the concrete.

Unless the base course is waterproof, it shall be uniformly moist when the concrete is placed.

501.03.10--Handling, Measuring and Batching Materials. The batch plant site, layout, equipment, and provisions for transporting material shall be sufficient to assure a continuous supply of material to the work. Stockpiles shall be built up in layers of not more than five feet in thickness. Each layer shall be completely in place before beginning the next, which shall not be allowed to

"cone" down over the next lower layer. Aggregates from different sources and of different gradings shall not be stockpiled together.

Aggregates shall be handled from stockpiles or other sources to the batching plant in a manner that will assure uniform grading of the material. Aggregates that have become segregated shall not be used until properly reblended. Aggregates contaminated with earth or foreign material shall not be used. All aggregates produced or handled by hydraulic methods and washed aggregates, shall be stockpiled or binned for draining at least 12 hours before being batched. Rail shipment requiring more than 12 hours will be accepted as adequate binning only if the car bodies permit free drainage. In case the aggregates contain a high or nonuniform moisture content, storage or stockpile periods in excess of 12 hours may be required by the Engineer.

The fine aggregate and each size of coarse aggregate shall be separately weighed into hoppers in the quantities set by the job-mix. Cement shall be measured by weight. Separate scales and hoppers, with a device to indicate the complete discharge of the batch of cement into the batch box or container, shall be used for weighing the cement.

Unless otherwise permitted by the contract, batching plants shall be equipped to proportion aggregates and bulk cement by weight using approved automatic and interlocked proportioning devices.

For on-site mixing, aggregates shall be transported from the batching plant to the mixer in batch boxes, vehicle bodies, or other containers of adequate capacity and construction to properly carry the volume required. Partitions separating batches shall be adequate and effective to prevent spilling from one compartment to another while in transit or being dumped. When bulk cement is used, the Contractor shall use a suitable method of handling the cement from weighing hopper to transporting container so as to assure the correct cement content in each batch. Bulk cement shall be transported to the mixer in separate and tight compartments carrying the full amount of cement required for the batch. Cement in original shipping packages may be transported on top of the aggregates with each batch containing the required number of sacks. Batches shall be delivered to the mixer separately and intact. Each batch shall be dumped into the mixer without loss of cement and, when more than one batch is carried on a truck, without spilling of material from one batch compartment into another.

Water may be measured either by volume or by weight. Unless the water is to be weighed, the water-measuring equipment shall include an auxiliary tank from which the measuring tank shall be filled. The measuring tank shall be equipped with an outside tap and valve to provide for checking the setting, unless other means are provided for readily and accurately determining the quantity of water in the tank. The volume of the auxiliary tank shall be at least equal to that of the measuring tank.

Methods and equipment for adding air entraining agent or other admixtures into the batch shall be approved by the Engineer.

The accuracy for measuring materials shall be in accordance with AASHTO Designation: M 157.

501.03.11--Mixing Concrete. The mixer shall be of an approved type and capacity. Mixing time shall be measured from the time all materials, except water, are in the drum. Ready-mixed concrete shall be mixed and delivered in accordance with requirements of Section 804.

When mixed at the site of the work or in a central mixing plant, the mixing time shall be that which will provide a satisfactory mixture, and unless otherwise specified in writing by the State Materials Engineer, the mixing time shall be not less than 50 seconds. When deemed necessary to insure a satisfactory mix, the State Materials Engineer may designate a mixing time suitable to obtain a satisfactory mixture. Four seconds will be added to the specified mixing time if timing starts the instant the skip reaches its maximum raised position. Mixing time ends when the discharge chute opens. Transfer time in multiple drum mixers is included in the mixing time. The contents of an individual mixer drum shall be emptied before a succeeding batch is placed therein.

The mixer shall be operated at the drum speed shown on the manufacturer's name plate on the mixer. All concrete mixed less than the specified time shall be discarded and disposed of by the Contractor at no cost to the State. The volume of concrete mixed per batch shall not exceed the mixer's nominal capacity in cubic feet, as shown on the manufacturer's standard rating plate on the mixer, except that an overload of up to 10 percent may be permitted provided concrete test data for strength, segregation, and uniform consistency are satisfactory, and provided no spillage of concrete takes place.

The batch shall be so charged into the drum that a portion of the mixing water enters in advance of the cement and aggregates. The flow of water shall be uniform and all water shall be in the drum by the end of the first 15 seconds of the mixing period. The throat of the drum shall be kept free of accumulations that might restrict the free flow of materials into the drum.

Mixed concrete from a central-mixing plant shall be transported in truck mixers, truck agitators, or nonagitating trucks having approved bodies. The elapsed time from when water is added to the mix until the concrete is deposited at the site of the work shall not exceed 30 minutes (45 minutes when a retarder is used) when the concrete is hauled in nonagitating trucks, or 60 minutes when hauled in truck mixers or truck agitators.

Retempering concrete by adding water or by other means will not be permitted. However, when concrete is delivered in transit mixers or agitators and if

permitted by the Engineer, additional water may be added to the batch materials and additional mixing performed to increase the slump to meet the specified requirements, provided all these operations are performed within 45 minutes after the initial mixing operation and the total amount of water in the concrete does not exceed the mix design amount. Concrete that exceeds the maximum slump at time of placement shall not be used. Admixtures for increasing the workability or for accelerating the set will be permitted only when specifically provided for in the contract, or when permitted in writing by the Engineer.

501.03.12--Limitations of Mixing. Except in emergencies, no concrete shall be mixed or placed when the natural light will be insufficient for finishing. In case of an emergency, the Engineer may permit finishing during periods of insufficient light provided adequate and approved lighting is furnished by the Contractor.

Concrete shall not be placed on a frozen foundation, nor shall frozen aggregate be used in the concrete.

During periods of cold or expected cold weather, the limitations for beginning a concrete pour and the limitations for temperature control of the mix and its components shall be in accordance with the provisions of Subsection 804.03.16.1.

During periods of hot weather or arid atmospheric conditions the provisions of Subsection 804.03.16.2 shall be applicable.

501.03.13--Placing Concrete.

501.03.13.1--General. Concrete shall be mechanically spread in an approved manner so as to distribute the concrete uniformly without segregation. On roadside areas such as driveways and parking areas for weigh stations or roadside parks, etc. and on other small or irregular areas the concrete may be placed by other approved methods.

The rate of delivery of the concrete shall be such that the interval between the discharge of the successive loads shall not exceed 20 minutes, and when air temperature is 90°F or higher the interval shall not exceed 15 minutes. Concrete that has begun to set up shall not be placed in the work.

All concrete materials that may fall on or be worked into the surface of a completed slab shall be removed immediately by approved methods.

501.03.13.2--Formed Pavement. The concrete shall be deposited on the grade in a manner that will require as little rehandling as possible.

For paneled pavement, placing shall be continuous between transverse joints

without the use of intermediate bulkheads. For continuously reinforced pavement, placing shall be continuous between construction joints without use of intermediate bulkheads. Necessary hand spreading shall be performed with shovels and not rakes. Workers shall not be allowed to walk in the freshly mixed concrete with boots or shoes coated with earth or foreign substances.

When concrete is to be placed adjoining a previously constructed lane of pavement and mechanical equipment will be operated upon the existing lane of pavement, that lane shall have attained the age of 14 days, exclusive of days on which the air temperature does not reach 35°F, or shall have attained a flexural strength of 600 pounds per square inch. If only light finishing bridges, or other similar light equipment, is partially carried on the existing lane, paving in the adjoining lanes will be permitted after three days.

Concrete shall be thoroughly consolidated against and along the faces of all forms and along the full length and on both sides of all joint assemblies, by means of vibrators inserted in the concrete. Vibrators shall not come in contact with a joint assembly, reinforcing steel, the base, or a side form. In no case shall the vibrators be operated longer than 15 seconds in one location.

Concrete shall be deposited as near to expansion and contraction joints as possible without disturbing them, but shall not be dumped onto a joint assembly unless the hopper is well centered on the joint assembly.

The Contractor shall have available at all times materials for the protection of unhardened concrete in the event of rain.

501.03.13.3--Slip-Form Pavement. The Contractor shall have sufficient forms available on the project for use in the event of an emergency.

In order that the concrete may be properly protected against the effects of rain before it has sufficiently hardened, the Contractor shall have available at all times materials for the protection of the edges and surface of the unhardened concrete. Protective materials shall include standard metal forms, or wood planks having a nominal thickness of at least two inches and a nominal width of not less than the thickness of the pavement, and covering material such as burlap or cotton mats, curing paper, or plastic sheeting material. When rain appears imminent, all paving operations shall stop, and all available personnel shall begin placing forms against the sides of the pavement and covering the surface of the unhardened concrete with the protective covering.

The concrete shall be of uniform consistency and placed, shaped, consolidated, and float finished by an approved slip-form paver. The slip-form paver shall be operated off of a taut stringline or wire set by the Contractor to true grade and alignment, except that if the grade at each form line, plus the width of the track of the paver, has been constructed within the tolerance allowed at the form line in

Subsection 321.03.7 the automatic control devices on the paver will not be required.

The equipment shall vibrate the concrete for the full width and depth of the strip of pavement being placed. Vibration shall be accomplished with vibrating tubes or arms working in the concrete or with a vibrating screed or pan operating on the surface of the concrete. No appreciable slumping of the in-place concrete will be allowed, and, if necessary, forms shall be trailed behind the paver to prevent slumping. If trailing forms are used, they shall be rigidly supported laterally.

The slipform paver shall be operated with as nearly a continuous forward movement as possible. If, for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall be stopped immediately.

Where sections of pavement are to be subsequently abutted with other lanes of pavement involving longitudinal or nearly longitudinal joints, the concrete adjacent to these joints shall be placed and finished as required by standard paving methods or by use of false forms, adjacent to the slip forms. The false forms shall be metal of sufficient gage to maintain the proper shape and continuity of the form line and shall be approved by the Engineer. The use of false forms shall be subject to satisfactory performance. If the Contractor is able to construct the pavement without measurable edge slump or misalignment, the Engineer may waive the use of the false form.

When required, bracing of the forms shall be accomplished so there will not be more than 10 feet of unbraced false forms. False forms shall remain in place of a minimum of 90 minutes or until forms can be removed without damaging the adjacent concrete.

501.03.14--Test Specimens. The Contractor shall furnish the concrete necessary for test specimens. The specimens shall be made and cured as specified in Mississippi Test Method: MT-5.

501.03.15--Strike-Off of Concrete and Placement of Reinforcement.

501.03.15.1--General. Reinforcing steel shall be free from dirt, oil, paint, grease, mill scale, and loose or thick rust which could impair bond of the steel with the concrete.

501.03.15.2--Bar Mat Reinforcement. When the pavement is placed in two layers, the entire width of the bottom layer shall be struck off to the length and depth that will permit the sheet of bar mat to be laid full length on the concrete in its final position without further manipulation. The reinforcement shall then be placed directly upon the bottom layer, after which the top layer shall be placed,

struck off, and screeded. All concrete in the bottom layer which has been placed more than 30 minutes without being covered with the top layer shall be removed and replaced with freshly mixed concrete at no additional costs to the State. When the pavement is placed in one layer, the reinforcement may be placed in the plastic concrete after spreading, by approved mechanical or vibratory means, or it may be positioned in advance of concrete placement on supports that will withstand, without displacement, all depositing, spreading, and vibrating operations.

501.03.15.3--Continuous Reinforcement. Steel for continuously reinforced pavement shall be placed by the first of the following methods or conditionally by the second method:

- (a) Steel shall be placed sufficiently in advance of the paving operation. It shall be supported on approved chairs, positioned, and tied in accordance with the plans.
- (b) Machine placement of steel for slip-form paving will be permitted provided the Contractor satisfactorily demonstrates that the equipment used will position the steel in accordance with the plans with the exception that transverse bars will be permitted to be placed on top of longitudinal bars.

501.03.16--Joints. Joints shall be constructed of the type and dimensions and at the locations required by the plans, or as directed.

Sawing of joints shall commence as possible after the concrete has hardened and before uncontrolled shrinkage cracking occurs. The saw blades, and skid plates if early entry method is used, shall be changed as often as necessary to control and minimize spalling/raveling. A sufficient number of saws, replacement blades and skid plates shall be available at the project site to insure that the sawing operations will proceed until completion without interruption.

Any damage to the concrete resulting from the sawing operations shall be corrected immediately after the sawing is complete at no additional costs to the State.

501.03.16.1--Longitudinal Joints. Deformed steel tie bars or transverse bars of specified length, size, spacing, and material shall be placed perpendicular to the longitudinal joints. They shall be placed by approved mechanical equipment or rigidly secured by chairs or other approved supports to prevent displacement. Tie bars shall not be painted or coated with asphalt or other material, or enclosed in tubes or sleeves.

When adjacent lanes of pavement are constructed separately, longitudinal construction joints shall be constructed in accordance with the details shown on the plans. Tie bars, except those made of rail steel, may be bent at right angles

against the form of the first lane constructed and straightened into final position before the concrete of the adjacent lane is placed.

The longitudinal center joint shall be installed so that its ends are in contact with transverse joints, if any.

Longitudinal joints shall be constructed by sawing or forming in accordance with the plans.

501.03.16.2--Transverse Expansion Joints. The expansion joint filler shall be continuous from form to form and shaped to the subgrade and to the keyway along the form. Preformed joint filler shall be furnished in lengths equal to the pavement width or equal to the width of one lane. Damaged or repaired joint filler shall not be used unless approved by the Engineer.

The expansion joint filler shall be held in a vertical position. An approved installing bar, or other device, shall be used if required to secure preformed expansion joint filler at the proper grade and alignment during placing and finishing of the concrete. Finished joints shall not deviate more than one-fourth inch in the horizontal alignment from a straight line. If joint fillers are assembled in section, there shall be no offsets between adjacent units. Plugs of concrete will not be permitted within the expansion space.

501.03.16.3--Transverse Contraction Joints. Transverse contraction joints shall consist of planes of weakness created by forming or sawing grooves in the surface of the pavement as shown on the plans and shall include load transfer assemblies when specified.

501.03.16.4--Transverse Construction Joints. Transverse construction joints shall be constructed when there is an interruption of more than 30 minutes in the concreting operation. Construction joints shall not be constructed within 10 feet of expansion joints, contraction joints, or planes of weakness. If sufficient concrete has not been mixed at the time of interruption to form a slab of at least 10 feet long, the excess concrete back to the last preceding joint shall be removed and disposed of as directed.

501.03.16.5--Load Transfer Devices. When dowel assemblies are used, the dowels shall be held in position parallel to the surface and center line of the slab.

For the slip-form method of concrete placement, dowel bars may be placed in the full thickness of pavement immediately following the paver with a vibratory inserter in lieu of using dowel assemblies. The vibratory dowel bar inserter shall be approved by the Engineer. The inserter shall vibrate the dowels into place accurately, at the proper location both vertically and longitudinally. An oscillating surface correcting beam shall follow immediately behind the inserter to correct surface deformation caused by the inserter. When a dowel bar inserter

is used, a skewed joint may be permitted with the approval of the Engineer.

The entire length of each dowel will be thoroughly coated with an approved lubricant to prevent adherence to the concrete.

501.03.16.6--Dowel Replacement. When designated on the plans, dowel replacement work shall consist of replacing damaged or deteriorated dowels in reconstructed contraction joints and both dowels and wooden joint filler boards in reconstructed expansion joints.

Dowel bars shall be the size and length designated on the plans. Wooden joint filler board shall conform to the dimensions shown on the plans.

New expansion boards shall be drilled to fit the new dowels installed. Special care shall be taken to ensure that all dowels in the joint remain parallel to the surface of the concrete.

501.03.17--Final Strike-Off, Consolidation and Finishing.

501.03.17.1--Sequence. The sequence of operations shall be the strike-off and consolidation, floating and removal of laitance, straight-edging, and final surface finish.

Concrete, as soon as placed, shall be struck off and screeded. An approved portable screed shall be used. A second screed shall be provided for striking off the bottom layer of concrete if reinforcement is used and the pavement is placed in two layers.

The screed for the surface shall be at least two feet longer than the maximum width of the slab to be struck off. It shall be of approved design, sufficiently rigid to retain its shape, and be constructed of metal or of other suitable material shod with metal.

Consolidation shall be attained by the use of a suitable vibrator or other approved equipment.

In operation the screed shall be moved forward with a combined longitudinal and transverse shearing motion, and manipulated so that neither end is raised from the side forms during the striking off process. If necessary, this shall be repeated until the surface is of uniform texture, true to grade and cross section, and free from porous areas.

In general, the addition of superficial water to the surface of the concrete to assist in finishing operations will not be permitted. If the application of water to the surface is permitted, it shall be applied as a fog spray by means of approved spray equipment.

501.03.17.2--Finishing at Joints. The concrete adjacent to joints shall be compacted or firmly placed without voids or segregation against the joint material, and also under and around all load transfer devices, joint assembly units, and other features designed to extend into the pavement. Concrete adjacent to joints shall be mechanically vibrated as required in Subsection 501.03.13.2.

After the concrete has been placed and vibrated adjacent to the joints, the finishing machine shall be brought forward, operating in a manner to avoid damage or misalignment of joints. If uninterrupted operation of the finishing machine, to, over, and beyond the joints causes segregation of concrete, damage to, or misalignment of the joints, the finishing machine shall be stopped when the front screed is approximately eight inches from the joint. Segregated concrete shall be removed from in front of and off the joint, and the front screed shall be lifted and set directly on top of the joint and the forward motion of the finishing machine resumed. When the second screed is close enough to permit the excess mortar in front of it to flow over the joint, it shall be lifted and carried over the joint. Thereafter, the finishing machine may be run over the joint without lifting the screeds, provided there is no segregated concrete immediately between the joint and the screed or on top of the joint.

501.03.17.3--Machine Finishing. Unless otherwise specified, full width vibration shall be performed. If uniform and satisfactory density of the concrete is not obtained by the vibratory method at joints, along forms, at structures, and throughout the pavement, the Contractor shall furnish equipment and methods which will produce pavement conforming to the specifications.

501.03.17.4--Hand Finishing. Unless otherwise specified, hand finishing methods, other than the hand floating method described below, will not be permitted except under the following conditions:

In the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade when the breakdown occurs.

Narrow widths or areas where operation of mechanical equipment is impractical may be finished by hand methods.

501.03.17.5 Floating. After the concrete has been struck off and consolidated, it shall be further smoothed and trued by means of a longitudinal float, using one of the following methods as specified:

- (a) **Hand Method.** The hand-operated longitudinal float shall be at least 12 feet long and six inches wide, properly stiffened to prevent flexibility and warping. The longitudinal float, operated from foot bridges spanning but not touching the concrete, shall be worked with a sawing motion while held in a floating position parallel to the road centerline,

and passing gradually from one side of the pavement to the other. Movement ahead along the centerline of the pavement shall be in successive advances of not more than one-half the length of the float. Excess water and soupy material shall be wasted over the sides on each pass.

- (b) **Mechanical Method.** The mechanical longitudinal float shall be of a design approved by the Engineer, and shall be in good working condition. The float shall be accurately adjusted to the required crown, and coordinated with the adjustments of the transverse finishing machine so that a small amount of mortar is carried ahead of the float at all times. The float shall pass over each area of pavement at least two times, but excessive operation over a given area will not be permitted. Excess water and soupy material shall be wasted over the sides on each pass.

As an alternative to the mechanical method, the Contractor may use a machine composed of a cutting and smoothing float, or floats, suspended from and guided by a rigid frame. The frame shall be carried by four or more visible wheels riding on and constantly in contact with the side forms, or track line of a slip-form paver.

If necessary, following one of the preceding methods of floating, long-handled floats having blades at least five feet long and six inches wide may be used to smooth and fill in open-textured areas in the pavement. Long-handled floats shall not be used to float the entire surface of the pavement in lieu of, or to supplement, one of the preceding methods of floating. When strike-off and consolidation are done by the hand method and the crown of the pavement will not permit the use of the longitudinal float, the surface shall be floated transversely by means of the long-handled float. Care shall be taken not to work the crown out of the pavement during the operation. After floating, excess water and laitance shall be removed from the surface of the pavement by a straightedge 10 feet or more in length. Successive drags shall be lapped one-half the length of the blade.

501.03.17.6--Straight-Edge Testing and Surface Correction. After the floating has been completed and while the concrete is still plastic, the surface of the concrete shall be tested with a 10 foot straightedge. For this purpose the Contractor shall furnish and use an accurate 10-foot straightedge swung from handles three feet longer than one-half the width of the slab. The straightedge shall be held in contact with the surface in successive positions parallel to the road centerline and the whole area gone over from one side of the slab to the other as necessary. Advance along the road shall be in successive stages of not more than one-half the length of the straightedge. All depressions found shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the requirements for

smoothness. Straightedge testing and surface corrections shall continue until the entire surface is found to be free from observable departures from the straightedge, and the slab conforms to the required grade and cross section.

501.03.18--Final Finish. The surface finish of the concrete shall be that designated on the plans and in the bid schedule of the contract. If a finish is not designated, the finish shall be a drag finish.

501.03.18.1--Drag Finish. This finish shall consist of a uniform surface of gritty texture produced by dragging a seamless strip of damp burlap or cotton fabric longitudinally along the full width of pavement. For pavement 16 feet or more in width, the drag shall be mounted on a bridge which travels on the forms or track line. The dimensions of the drag shall be such that a strip of burlap or fabric at least three feet wide is in contact with the full width of pavement surface while the drag is used. The drag shall consist of at least two layers of burlap with the bottom layer approximately six inches wider than the upper layer. The drag shall be maintained in a condition that will produce a surface of uniform appearance with corrugations approximately one-sixteenth inch in depth. Drags shall be maintained clean and free from encrusted mortar. Drags that cannot be cleaned shall be discarded and new drags substituted.

501.03.18.2--Broom Finish. A broom finish shall be applied when the water sheen has practically disappeared. The broom shall be drawn from the center to the edge of the pavement with adjacent strokes slightly overlapping. The brooming operations shall produce corrugations in the surface that are uniform in appearance and not more than 1/16 inch in depth. Brooming shall be completed before the concrete has set to a degree that the surface will be torn or unduly roughened by the operation. The finished surface shall be free from rough and porous areas, irregularities, and depressions. Brooms shall be of the quality, size, and construction and operated so as to produce a surface finish meeting the approval of the Engineer. Subject to satisfactory results being obtained and approval of the Engineer, the Contractor will be permitted to substitute mechanical brooming in lieu of manual brooming as herein described.

501.03.18.3--Belt Finish. When straight-edging is complete and the water sheen has practically disappeared and just before the concrete becomes nonplastic, the surface shall be belted with a two-ply canvas belt eight inches wide and at least three feet longer than the pavement width. Hand belts shall have suitable handles to permit controlled, uniform manipulation. The belt shall be operated with short strokes transverse to the road centerline and with a rapid advance parallel to the center line. Subject to satisfactory results being obtained and approval of the Engineer, the Contractor will be permitted to substitute mechanical belting in lieu of manual belting as herein described.

501.03.18.4--Transverse Tine Finish. The surface shall first be given a drag finish. After completion of the drag finish, the pavement shall be given an

additional texture by transverse tining.

The final surface texture shall be produced with a metal tine finishing device meeting the requirements of Subsection 501.03.5.5. The texturing device shall be so constructed and operated as to produce uniform parallel grooves perpendicular to the centerline of the pavement 1/2 inch on centers and having a depth of 1/8 inch, plus or minus 1/32 inch.

The metal tine device shall be operated by approved mechanical means when texturing main roadway pavement lanes. Manual methods may be used for texturing small irregular areas inaccessible to the texturing machine.

The depth of the finished grooves will be determined by the use of a standard commercial tire tread depth measuring gauge with 1/32 inch graduations that can be easily and accurately read, a brass wire brush, and a steel straightedge approximately 1/4 inch x 1 inch x 12 inches. The Contractor shall furnish this equipment for use by and subject to the approval of the Engineer. The method of measuring the depth of grooves will be as set out in Department SOP.

If for any reason the concrete hardens to the extent that the tining equipment does not provide grooving in accordance with these requirements, or if rainfall damages the finish and the Engineer permits the concrete to remain in place, the Contractor shall use other approved devices such as saws to construct the grooves substantially in accordance with the requirements specified herein.

501.03.18.5--Transverse Grooved Finish. After the concrete has cured for a minimum of seven (7) days, areas to be transverse grooved shall be grooved with a sawing device meeting the requirements of Subsection 501.03.5.5.2. Grooves shall be perpendicular to the centerline of the roadway and extend as close as possible to the edge but in no case more than two (2) feet from the edge, gutter line, etc. The tolerance for the width of the groove is +1/16" to -0" and the tolerance for the depth and spacing of the grooves is $\pm 1/16$ ".

501.03.18.6--Edging at Forms and Joints. After the final finish, but before the concrete has taken its initial set, the pavement along each side of each slab, and on each side of transverse expansion joints, formed joints, transverse construction joints, and emergency construction joints shall be worked with an approved tool and rounded to the radius required by the plans. A well-defined and continuous radius shall be produced and a smooth, dense, mortar finish obtained. The surface of the slab shall not be unduly disturbed by tilting of the tool during use.

At all joints, all tool marks appearing on the slab adjacent to the joints shall be eliminated by brooming the surface. In doing this, the rounding of the corner of the slab shall not be disturbed. All concrete on top of the joint filler shall be completely removed.

All joints shall be tested with a straightedge before the concrete has set, and correction made if one side of the joint is higher than the other, or if they are higher or lower than the adjacent slabs.

501.03.19--Surface Test. It is the intent of these specifications that the finished surface will have good riding qualities.

Profiles of the mainline pavement surface will be established, evaluated and the pavement surface corrected, as necessary, so that the final surface variances shall not exceed a profile index of 30 inches per mile per segment. Mainline pavement is defined as all pavements other than shoulders, parking lanes, ramps, tapers, acceleration and deceleration lanes, bridge decks, and bridge approach slabs. Determination of the profile index will be in accordance with test methods established by the Department.

A California profilograph meeting the requirements as set out in Section 401 shall be furnished and operated by the Contractor under supervision of the Engineer to provide recorded data to establish the profile index and identify locations requiring correction. Surface profile shall be obtained in the wheel path of each travel lane.

During initial paving operations, either when starting up or after a long shut down period, the pavement surface will be tested with profilograph as soon as the concrete has cured sufficiently to allow testing. Membrane curing damaged during the testing operation shall be repaired by the Contractor. The purpose of this testing is to aid the Contractor and the Engineer in evaluating the paving methods and equipment. For the purpose of determining pavement smoothness and contract price adjustment for rideability, each day's production will be subdivided into sections which terminate at bridges, transverse joints or other interruptions. Each section will be sub-divided into segments of 528 feet. Where a segment less than 528 feet occurs at the end of a section, it will be combined with the preceding 528-foot segment for calculation of the profile index. The last 15 feet of a day's production may not be obtainable until the paving operation is continued and for this reason may be included in the subsequent segment. If a day's paving is less than 50 feet, it shall be tested using the ten-foot straightedge, and shall be included in the subsequent day's production profile.

A profile index will be determined for each segment as inches per mile in excess of the "Zero" blanking band which is simply referred to as the "Profile Index". From the profilogram of each segment, the scallops above and below the "Zero" blanking band are totaled in tenths of an inch. The totaled count of tenths is converted to inches per mile to establish a smoothness profile index for that segment.

In addition to the above requirements for the profile index, all areas represented by high points having deviations in excess of 0.3 inch in 25 feet shall be removed

by the Contractor utilizing grinding methods and equipment specified. Deviations in excess of 0.3 inch will be determined from the profilogram in accordance with Department test methods.

After correcting individual deviations in excess of 0.3 inches in 25 feet, corrective action shall be made to reduce the profile index to 30 inches per mile per segment or less.

On those segments where corrections are made, the pavement will be tested to verify that corrections have produced a profile index of 30 inches per mile per segment or less.

Corrections shall be made using an approved profiling device or by removing and replacing the pavement as directed by the Engineer. Corrective work shall be performed at no additional cost to the State.

Each area or section of pavement removed shall be at least 10 feet in length and at least the full width of the lane involved. When it is necessary to remove and replace a section of pavement, any remaining portion of the slab adjacent to the joints that is less than 10 feet in length shall also be removed and replaced. The new surface shall be textured as specified in the contract.

Where surface corrections are made, the Contractor shall reestablish the surface texture to a uniform texture equal in roughness to the surrounding uncorrected pavement. This work shall be at no additional cost to the State.

Corrective work shall be completed prior to determining pavement thickness.

501.03.19.1--Diamond Grinding. Grinding of concrete surfaces shall consist of diamond grinding the existing portland cement concrete surface to remove surface distortions to achieve the specified surface smoothness requirements.

501.03.19.1.1--Equipment. The grinding equipment shall be a power driven, self-propelled machine that is specifically designed to smooth and texture portland cement concrete surfaces with diamond blades. The effective wheel base of the machine shall not be less than 12.0 feet. It shall have a set of pivoting tandem bogey wheels at the front of the machine and the rear wheels shall be arranged to travel in the track of the fresh cut pavement. The center of the grinding head shall be no further than 3.0 feet forward from the center of the back wheels.

The equipment shall be of a size that will cut or plane at least 3.0 feet wide. It shall also be of a shape and dimension that does not encroach on traffic movement outside of the work area. The equipment shall be capable of grinding the surface without causing spalls at cracks, joints, or other locations.

501.03.19.1.2--Construction. The construction operation shall be scheduled and

proceed in a manner that produces a uniform finish surface. Grinding will be accomplished in a manner to provide positive lateral drainage by maintaining a constant cross-slope between grinding extremities in each lane.

The operation shall result in pavement that conforms to the typical cross-section and the requirements specified in Subsection 501.03.19.1.3. It is the intent of this specification that the surface smoothness characteristics be within the limits specified.

The Contractor shall establish positive means for removal of grinding residue. Solid residue shall be removed from pavement surfaces before it is blown by traffic action or wind. Residue shall not be permitted to flow across lanes used by public traffic or into gutters or drainage facilities, but may be allowed to flow into adjacent ditches.

501.03.19.1.3--Finished Concrete Surface. The grinding process shall produce a pavement surface that is smooth and uniform in appearance with a longitudinal line type texture. The line type texture shall contain parallel longitudinal corrugations that present a narrow ridge corduroy type appearance. The peaks of the ridges shall not be more than 1/16 inch higher than the bottoms of the grooves.

The finished pavement surface will be measured for riding quality. The grinding shall produce a mainline riding surface which does not exceed either the specified profile index or the specified bump and dip limit.

501.03.20--Curing and Protection. Immediately after the finishing operations have been completed and as soon as marring of the concrete will not occur, the entire surface of the newly placed concrete shall be covered and cured in accordance with one of the following methods. On hot or windy days, and when directed by the Engineer, the surface of the fresh concrete shall be kept damp by fogging with water until the normal curing operation can be performed. In all cases in which curing requires the use of water, the curing shall have prior right to all water supplies. Failure to provide sufficient cover material of whatever kind the Contractor may elect to use, or lack of water to adequately take care of both curing and other requirements, shall be cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than 1/2 hour between stages of curing or during the curing period. Unless otherwise specified, the curing period shall be 72 hours.

501.03.20.1--White Pigmented Membrane. The entire surface of the pavement shall be sprayed uniformly with white pigmented curing compound immediately after the finishing of the surface and before the set of the concrete has taken place. The curing compound shall not be applied during rainfall or when there is a water sheen on the pavement.

Curing compound shall be applied under pressure at the rate of one gallon to not more than 150 square feet for all surface finishes except transverse grooving. For transverse groove finishes, the application shall be at the rate of one gallon to not more than 120 square feet. The spraying equipment shall be of the fully atomizing type equipped with a tank agitator. At the time of use, the compound shall be in a thoroughly mixed condition with the pigments uniformly dispersed throughout the vehicle. During application, the compound shall be stirred continuously by effective mechanical means. Hand spraying of odd widths or shapes and on concrete surfaces exposed by the removal of forms will be permitted. Curing compound shall not be applied to the faces of joints to be sealed, and those faces shall be cured by other approved means for at least 72 hours.

The curing compound shall be of such character that the film will harden within 30 minutes after application. Should the film become damaged from any cause within the curing period, the damaged portions shall be repaired immediately with additional compound.

Upon removal of side forms, the sides of the slabs exposed shall be protected immediately to provide a curing treatment equal to that provided for the surface.

501.03.20.2--White Polyethylene Sheeting. The top surface and sides of the pavement shall be entirely covered with polyethylene sheeting. The pieces used shall be lapped at least 18 inches. The sheeting shall be so placed and weighted down that it will remain in direct contact with the surface covered. The sheeting shall be wide enough to extend 18 inches beyond the edges of the slab being cured.

501.03.20.3--Curing in Cold Weather. When concrete is being placed and the air temperature may be expected to drop below 35°F, a sufficient supply of straw, hay, grass, or other suitable blanketing material shall be provided to protect the work. The Contractor shall be responsible for the quality and strength of the concrete placed during cold weather, and all concrete injured by frost action shall be removed and replaced at no additional cost to the State. The Department reserves the right to perform destructive or nondestructive testing for evaluation of damage caused by cold weather.

501.03.20.4--Protection of Pavement. The Contractor shall protect the pavement from both public traffic and traffic caused by employees and agents. This shall include watchmen to direct traffic and the erection and maintenance of warning signs, lights, pavement bridges, or crossovers, etc. The plans or special provisions will indicate the location and type of device or facility required to protect the work and provide adequately for traffic. The Contractor shall have materials available at all times to protect unhardened concrete from rain.

All damage to the pavement, occurring prior to final acceptance, shall be repaired

or the pavement replaced.

501.03.21--Removing Forms. Except for auxiliary forms used temporarily in widened areas or unless otherwise provided, forms shall not be removed from freshly placed concrete until it has set for at least 12 hours. Forms shall be removed carefully so as to avoid damage to the pavement. After the forms have been removed, the sides of the slab shall be cured as outlined in one of the methods indicated in the previous subsection. Honeycombed areas shall be satisfactorily repaired.

501.03.22--Sealing Joints. Joints to be sealed shall be filled with joint sealing material meeting the requirements of Subsections 707.02.1.3 or 707.02.1.4, as shown on plans, and Subsection 707.02.1.5 before the pavement is opened to traffic, and as soon after completion of the curing period as is feasible.

501.03.22.1--Cleaning. Joints shall be clean, dry and frost free when the sealant is applied. Formed joints shall be thoroughly cleaned to remove all form release agents, curing compound residue, laitance, or any other foreign materials. All joints shall be thoroughly cleaned by sandblasting each face separately to the depth of the sealer and backer rod. The cleaning operation of existing joints shall ensure that the concrete joint surfaces which are to receive the new joint sealant and backer rod are free of all debris, discoloration and stain; as well as any and all other forms of contamination. If a clean exposed concrete surface cannot be obtained by sandblasting, the joints shall be refaced with a power driven concrete saw with diamond and/or abrasive blades. The refaced joints shall be washed and sandblasted as set forth above. Immediately prior to installation of the backer rod, the joints shall be cleaned with compressed air which is free of moisture and oil. Wiping fingers on cleaned surface of joints shall not show evidence of dust. The joints shall be completely free of sand, oil and moisture.

Material in expansion joints shall be removed to the required depth with a power saw and/or router in such a manner as not to damage the expansion material which is to remain in place.

501.03.22.2--Installing Backup Material. After the final cleaning, a resilient rod type backup material shall be installed with a positioning device to insure conformity with the dimensions shown on the plans. The rod shall be compatible with the sealant and no bond or reaction shall occur between the rod and the sealant.

501.03.22.3--Installing Sealant. The installation of the sealant is to be performed as soon after placing the backer rod as reasonably possible to ensure that joints are still clean and dry. In the event a joint does become contaminated, damp, or wet, the backer rod is to be removed and the joint cleaned and dried with a new backer rod reinstalled prior to placing the sealant. The ambient temperature at time of placement must be 40°F or higher. The sealant shall be

applied by pumping only. The pump shall be of sufficient capacity to deliver the necessary volume of material to completely fill the joint to the specified width and height of sealant in one pass. The nozzle shall be of sufficient size and shape to introduce the sealant inside the joint with sufficient pressure to prevent voids occurring in the sealant and force the sealant to make contact with the joint faces. The sealant shall be tooled to provide the specified recess depth, thickness and shape as shown on the plans. Sufficient force or pressure shall be applied to the sealant in this tooling operation to force the sealant against the joint faces to ensure satisfactory wetting and bonding. The sealant shall be placed to reasonably close conformity with dimensions and shape shown on the plans. Any unreasonable deviation will be cause for rejection and necessary corrective action will be made by the Contractor.

501.03.22.4--Cleaning Pavement. After a joint has been sealed, all surplus sealant on the pavement shall be promptly removed.

501.03.23--Opening to Traffic. The Engineer will decide when the pavement may be opened to traffic. The pavement shall not be opened to traffic until test specimens have attained a compressive strength of 3500 pounds per square inch. If such tests are not performed, the pavement shall remain closed to traffic for 14 days, or 28 days if Type IP cement or Type I or II portland cement with fly ash is used, from the date of placement. Prior to opening to traffic, the pavement shall be cleaned.

501.03.24--Tolerance in Pavement Thickness. The thickness of the pavement will be determined from cores taken in accordance with Subsection 501.03.24.1 and tested in accordance with Subsection 700.03. Holes remaining in the pavement after coring shall be completely filled by the Contractor, at no additional cost to the State, with concrete of the same quality as used to construct the pavement.

It is anticipated that when portland cement concrete pavement is placed over an asphalt treated base, the concrete may penetrate the asphalt treated base. Volumes of portland cement concrete that penetrate the asphalt treated base will not be included in the volume of concrete pavement to be paid for.

When cores are taken to determine the thickness of portland cement concrete pavement, it is anticipated a layer of asphalt treated base will adhere to the bottom of the core. Prior to determining the thickness of the portland cement concrete pavement, all particles of asphalt treated base will be removed from the bottom of the core. Measurement of core thicknesses will be made from top of portland cement concrete pavement to the top of the asphalt treated base.

501.03.24.1--Thickness Determination. For the purpose of establishing adjusted unit prices for pavement, units to be considered separately are defined as 1000 linear feet of pavement in each traffic lane. Each traffic lane will be

divided into units of 1000 feet of pavement, excluding exceptions and omissions, beginning at the end of the pavement nearest the Beginning of Project. The last unit in each lane will be the length remaining except that if the length is less than 100 feet, it will be included in the previous unit. Each project under the same contract will be separated into units independently of the other projects. One core will be taken at random by the Department in each unit. When the measurement of the core from a unit is not deficient more than 0.2 inch from the plan thickness, full payment will be made. When the measurement is deficient by more than 0.2 inch and not more than 1.0 inch from the plan thickness, that measurement will represent the one-third of the section in which it falls, and one additional core will be taken at random in each of the remaining thirds of the section. The average thickness of these three cores will determine the average thickness for that unit. An adjusted unit price as provided in Subsection 501.05.2 will be paid for the unit represented.

Other areas such as intersections, entrances, crossovers, ramps, etc., will be considered as separate units, and the thickness of each unit will be determined separately. Small irregular unit areas may be included as part of another unit. The areas to be included in each unit will be predetermined. At points the Engineer may select at random in each unit, one core will be taken for each 1000 square yards of pavement, or fraction thereof, in the unit. If the core taken is not deficient more than 0.2 inch from the plan thickness, full payment will be made. If the core is deficient in thickness by more than 0.2 inch but not more than 1.0 inch from plan thickness, two additional cores will be taken at random from the area represented and the average of the three cores determined. If the average measurement of these three cores is not deficient more than 0.2 inch from the plan thickness, full payment will be made. If the average thickness of the three cores is deficient more than 0.2 inch but not more than 1.0 inch from the plan thickness, an adjusted unit price as provided in Subsection 501.05.2 will be paid for the area represented by these cores.

In calculating the average thickness of the pavement, measurements which are in excess of the specified thickness by more than 0.2 inch will be considered as the specified thickness plus 0.2 inch, and measurements which are less than the specified thickness by more than 1.0 inch, excluding exploratory cores, will be considered as the specified thickness minus 1.0 inch in the average.

When the measured thickness of a core is less than the plan thickness by more than 1.0 inch, the actual thickness of the pavement in this area will be determined by taking exploratory cores at not less than 10 foot intervals parallel to the centerline in each direction from the affected location until in each direction a core is found which is not deficient by more than 1.0 inch. Areas found deficient in thickness by more than 1.0 inch will be evaluated by the Engineer; and if in the judgment of the Engineer, the deficient areas warrant removal, they shall be removed and replaced with pavement of the thickness shown on the plans without cost to the Department. If the Engineer determines that the deficient

areas do not warrant removal, the pavement may be left in place with no payment to the Contractor, or may be removed and replaced at the Contractor's option. Exploratory cores for deficient thickness will not be used in averages for areas for adjusted unit price.

501.03.24.2--Alternate to Coring. For contracts on which less than 7,500 square yards of pavement is placed, cores will not be taken unless the State Materials Engineer elects to do so.

For such contracts, the Project Engineer's measurements will be used to determine the pavement thickness as follows:

The Engineer will accurately measure, by taut stringline or instrument from referenced grades, and record the grade on which the pavement is to be placed. After the pavement is in place, the Engineer will accurately measure and record the grade of the top of the pavement above each point where the initial measurements were made.

From the measurements thus made, the thickness of each area will be determined, unless the State Materials Engineer elects to take the cores as provided in this subsection. In the latter case the measurements made from cores will govern.

501.04--Method of Measurement. Concrete pavement will be measured by the square yard complete in place and accepted. The width for measurement will be the plan width, including widening where called for, or as otherwise authorized in writing by the Engineer. The length will be measured horizontally in accordance with Section 109.

Where integral or raised edge curb is constructed, the width of the pavement will include the width of the curb.

When specified for payment, expansion joints complete and accepted, will be measured by the linear foot.

Reinforced concrete lug anchors will be measured by the linear foot.

Reinforcement and other materials for which no pay item is included in the contract will not be measured for separate payment.

When rehabilitating existing pavement, dowels will be measured per each and wooden joint filler board shall be measured by the linear foot. All concrete removed will be measured by the square yard under pay item 202-B.

When a pay item is included in the contract, transverse grooving will be measured by the square yard, complete in place and accepted. For bridge decks,

the quantity will be computed by measuring the limits of transverse grooving shown in the plans. When not shown, the quantity will be computed by measuring the bound area between the face of barrier rail and the length of the span. For concrete and bridge end pavements, the quantity will be computed by measuring by the limits of transverse grooving shown in the plan. When not shown, the quantity will be computed by measuring the bound area between the edge of pavement and the length of the pavement.

501.05--Basis of Payment.

501.05.1--General. Concrete pavement will be paid for at the contract unit price per square yard, adjusted when applicable in accordance with Subsections 501.05.2 and 501.05.3.

Expansion joints will be paid for at the contract unit price per linear foot.

Reinforced concrete lug anchors will be paid for at the contract unit price per linear foot.

Transverse grooving, measured as prescribed above, will be paid for at the contract unit price per square yard, which price shall be full compensation for all grinding, cleaning and sweeping; and for all labor, equipment, tools and incidentals necessary to complete the work.

When rehabilitating existing pavement, dowel bars and expansion board will be paid for at the contract unit price per each and linear foot, respectively, which shall be full compensation for furnishing all labor, equipment, tools and materials to complete the work. No separate payment will be made for cutting off dowel bars left in the existing pavement. Unless otherwise noted, the price for dowel replacement work shall include the cost of continuous maintenance of traffic and protective services as required by the Department's Traffic Control Plan. This shall include all required individual traffic control devices.

The prices thus paid shall be full compensation for completing the work.

Payment will be made under:

- 501-A: ____ " Reinforced Cement Concrete Pavement,
 Type, Designation Finish - per square yard
- 501-B: ____ " Plain Cement Concrete Pavement, Type,
 Designation Finish - per square yard
- 501-C: ____ " Continuously Reinforced Cement Concrete
 Pavement, Type, Designation Finish - per square yard

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501-D: Expansion Joints with Dowels

501-E: Expansion Joints without Dowels

501-F: Concrete Lug Anchors

501-G: Dowels, Drilled and Installed

501-H: Dowels, Installed

501-I: Joint Filler, Wooden Board

501-K: Transverse Grooving

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- per linear foot

- per linear foot

- per linear foot

- per each

- per each

- per linear foot

- per square yard

501.05.2--Price Adjustments for Thickness. Where the average thickness of pavement determined in accordance with Subsection 501.03.24.1, or with Subsection 501.03.24.2, is deficient in thickness by more than 0.2 inch, but not more than 1.0 inch, payment will be made at an adjusted price as specified in the following table:

Thickness Deficiency Inches	Proportional Part of Contract Price Allowed
0.00 to 0.20	100 percent
0.21 to 0.30	80 percent
0.31 to 0.40	72 percent
0.41 to 0.50	68 percent
0.51 to 0.75	57 percent
0.76 to 1.00	50 percent

When the thickness of an area of pavement is deficient by more than 1.0 inch and, in the judgment of the Engineer, the deficient area should be removed, the area shall be removed and replaced at no additional costs the State with pavement of the specified thicknesses. If, in the judgment of the Engineer, the deficiency does not warrant removal, the deficient area may be left in place with no payment to the Contractor, or may be removed and replaced at no additional cost to the Department, at the Contractor's option.

501.05.3--Price Adjustments for Smoothness. When the profile index is less than or equal to twenty-two inches per mile (22.0 inches / mile) per segment, a unit price increase will be added. The following schedule lists the Profile Index range and the corresponding contract price adjustment.

Profile Index Inches Per Mile Per Segment	Adjustment Price Per Square Yard Of PCC Pavement
less than 10.0	plus \$ 0.26
10.0 to 14.0	plus \$ 0.20
14.1 to 18.0	plus \$ 0.13
18.1 to 22.0	plus \$ 0.07
22.1 to 30.0	\$ 0.00
Over 30.0	\$ 0.00 (With Correction of $PI \leq 30.0$)

The adjusted unit price will be computed using the contract unit price of the portland cement concrete pavement. This adjusted unit price will apply to the total area of the 0.1-mile segment for the lane width represented by the profilogram.

For concrete pavement other than main-line pavement, the surface will be tested using a 10-foot straightedge at locations selected by the Engineer. The variation of the surface from the testing edge of the straightedge between any two contacts, longitudinal or transverse with the surface, shall not exceed 1/4 inch. Irregularities exceeding the specified tolerances shall be corrected, at no additional cost to the State, by the Contractor with an approved profiling device or by other means as directed by the Engineer. Following correction, the area will be retested to verify compliance with the specified tolerances.

**SECTION 502 - PORTLAND CEMENT CONCRETE
BRIDGE END PAVEMENT**

502.01--Description. This work consists of bridge end pavement of portland cement concrete with reinforcement as shown on the plans, constructed in one course on a prepared base in accordance with these specifications, and in reasonably close conformity with the lines, grades, thickness, and cross section shown on the plans or as directed.

502.02--Materials. On bituminous paving contracts, concrete for this work may be Class "B" Structural Concrete meeting the applicable requirements of Subsection 804.02. Sampling and testing of concrete for acceptance and control purposes shall be in accordance with Subsection 804.02.3.

Reinforcing steel shall meet the requirements of Subsection 711.02.

502.03--Construction Requirements.

502.03.1--General. The requirements specified for concrete pavement in Section 501, shall apply in all respects to bridge end pavement except where otherwise indicated in the specific requirements below, or on the plans.

When the plans specify a certain thickness of hot mix asphalt under the bridge end pavement, the Contractor may substitute Class "B" Structural Concrete base in lieu of the hot mix asphalt. The concrete base shall be constructed in one course on a prepared base in accordance with these specifications, and in reasonably close conformity with the lines, grades, thickness, and typical cross-sections as shown on the plans or as directed. The concrete base will be allowed to cure 24 hours prior to placement of the bridge end pavement. A one-inch premolded expansion joint will be required along the face of the paving bracket. See Section 403 for measurement and payment of substituted concrete base material.

502.03.2--Specific Requirements.

502.03.2.1--Final Screeding and Finishing. The final screeding shall be performed by hand methods. The concrete shall be screeded longitudinally using the bridge floor for a gauge on one end, and a temporary bulkhead cut and securely installed true to crown and grade on the other end. In the event the concrete pavement, adjacent to the bridge end pavement, has been previously poured, the end of the pavement shall be used as a gauge in lieu of the temporary bulkhead. The final finish of the bridge end pavement shall be that designated on the plans. If a finish is not designed, the finish shall be transverse tined finish.

502.03.2.2--Joints. Concrete bridge end pavement shall be constructed monolithically, unless construction joints are specifically indicated on the plans.

502.04--Method of Measurement. Portland cement concrete bridge end pavement, complete in place and accepted, will be measured as specified in Subsection 501.04.

502.05--Basis of Payment. Portland cement concrete bridge end pavement will be paid for at the contract unit price per square yard in accordance with the methods as provided in Subsection 501.05. The prices thus paid shall be full compensation for completing the work.

Payment will be made under:

502-A: Reinforced Cement Concrete Bridge End Pavement - per square yard

SECTION 503 - REPLACEMENT OF CONCRETE PAVEMENT

503.01--Description. This work consists of replacing continuously reinforced

and/or reinforced (jointed) concrete pavement and the removal and replacement of base materials at locations designated on the plans or as determined by the Engineer all in accordance with the plans and specifications.

503.02--Materials. Materials shall meet the requirements of Subsection 700.01 and the following Subsections of Division 700, Materials and Tests.

Portland Cement	701.01 and 701.02
Fine Aggregate	703.01 and 703.02
Coarse Aggregate	703.01 and 703.03
Concrete Admixtures	713.02
Water	714.01
Concrete Reinforcement Bars	711.02
Longitudinal Joint Filler	707.02
Curing Materials	713.01

503.03--Construction Requirements.

503.03.1--Equipment. Equipment shall meet the requirements set out in Section 501 for hand placement and finishing portland cement concrete pavement. Batching and mixing equipment shall meet the applicable requirements of Section 804. On-site mixers or truck mixers will be permitted.

503.03.2--Removal of Existing Pavement.

503.03.2.1--General. Existing pavement shall be removed in accordance with details shown on the plans and as specifically set out herein. Removal will be measured for payment as set forth in Section 202. The Contractor shall dispose of the concrete in accordance with Section 201.

Equipment and methods used in all of the work shall not damage any of the underlying base and materials that are to remain in place. All materials which are removed from the roadway shall be disposed of daily.

503.03.2.2--Reinforced Concrete Pavement. The removal of existing reinforced concrete pavement shall be accomplished by sawing the full thickness of the pavement along the edge of the repaired areas as shown on the plans and/or as directed by the Engineer.

503.03.2.3--Continuously Reinforced Concrete Pavement. The pavement within the lap area shall not be disturbed, damaged, or removed until the continuity of the concrete and steel has been severed between the failed area and the lap area. This shall be accomplished by sawing the full thickness of the pavement along the edge of the lap area. Jack hammers used for cutting and removal of the concrete in the lap area shall not exceed 20 pounds.

The concrete in the lap area shall be removed in such a manner to result in a near vertical face at the saw line of the repair area. A chipping type removal is required to prevent spalling the bottom of the pavement to remain. Any spalling in excess of one and one-half inches shall be corrected by enlarging the repair area at no additional cost to the State. All shattered and damaged concrete shall be removed and the exposed faces cleaned.

The reinforcing steel in the lap area shall not be bent more than four inches in twenty inches from its original position. Where more than 10 percent of the steel is damaged in the lap area along any one edge of a removed area, the patch shall be enlarged at no additional cost to the State to provide the specified lap. Where less than 10 percent of the steel is damaged, the bars may be repaired by welding.

The steel shall be inspected for excessive rusting and evidence of distress during the removal process. The Engineer may enlarge the patch to remove deteriorated steel from the lap area. When the patch is enlarged by the Engineer, payment will be made for such removal.

503.03.3--Removal of Base Material. Base material referred to herein and on the plans shall be all types of material below the pavement that requires removal and backfill. The material shall be removed to the dimensions and depths designated by the Engineer. Removal of all undercut materials shall be in accordance with Section 202 and measured for payment by the square yard of base. The Contractor shall dispose of the material in accordance with Section 201.

503.03.4--Installation of Smooth Dowel Bars. Smooth dowel bars shall be installed in accordance with details shown on the plans and as specifically set out herein.

The commercial grout system used shall be one of the systems specified in Subsection 714.11.7. Installation and acceptance procedures are also included therein.

After the dowel bars are installed, the placement of reinforcing steel and any other work that may disturb the setting of the grout will not be permitted.

503.03.5--Installation of Tie Bars. The tie bars, except when directed otherwise on the plans, shall be No. 5 deformed bars, 30 inches long, placed on 24-inch centers and grouted using a commercial grout. The drilled holes shall be partially filled with an epoxy grout and the tie bars inserted to ensure that the holes are completely filled.

The commercial grout system used shall be one of the systems specified in Subsection 714.11.7. Installation and acceptance procedures are also included therein.

After the tie bars are installed, the placement of reinforcing steel and any other work that may disturb the setting of the grout will not be permitted.

503.03.6--Base and Pavement Replacement. Repair of the base and pavement shall conform to the requirements set forth herein and details shown on the plans. The exposed faces of the concrete pavement, the soil cement base and/or polyethylene covering the base repair shall be sprayed with water just prior to pouring the new slab.

The applicable provisions of Section 501 shall be adhered to with the following exceptions:

- (a) Concrete. Structural concrete for pavement repair shall be made of Portland cement or Portland cement with additives and/or admixtures. The use of additives or admixtures shall be in accordance with the manufacturer’s instructions. The Contractor shall submit a proposed concrete mix design to the Mississippi Department of Transportation Materials Division for approval at least two weeks prior to use on the project.

This concrete shall also meet the requirement for a compressive strength of 3500 psi within 72 hours. To meet these requirements, a Type F or G high range water reducing admixture shall be used. If the ambient temperature is less than 50°F, the addition of a Type C or E acceleration admixture shall be used. The usage of admixtures shall be in accordance with manufacturer’s instructions.

Air Content 3 to 6%
Slump 8” maximum*

* No requirement for an initial slump before the addition of the high range water reducer.

Field verification trial mix results must be provided to the Engineer prior to placement if there is no previous data to verify strength.

- (b) Forms. The forms may be metal or wood. Where at all possible, the forms shall be metal. Metal form shall meet the requirements of Subsection 501.03.6.2 and the wood forms shall be made of 2 x 8 lumber. Forms shall be graded to a specified elevation as directed by the Engineer.
- (c) Longitudinal Joints. Where a repair area is required to extend across a longitudinal joint, a preformed or sawed longitudinal joint shall be constructed and sealed as shown on the plans or as directed by the Engineer.

- (d) Consolidating and Finishing. All concrete shall be thoroughly consolidated by internal vibration. Finishing may be performed by either machine or hand methods. All patches less than 20 feet in length shall be screeded longitudinally unless otherwise permitted by the Engineer.

The surface of the pavement shall be finished as designated elsewhere in the contract and in accordance with the applicable portions of Section 501.

The screed shall be metal of a type used on bridges for finishing short patches and may be a mechanical or bridge type on long patches exceeding 20 feet. All replacement concrete shall be checked longitudinal with a 10-foot straightedge in accordance with Subsection 501.03.19 for concrete pavement other than main-line pavement.

- (e) Curing and Protection. Concrete cylinders used to represent the minimum compressive strength shall be field cured and cured by the same methods used on that portion of the roadway it represents. If the ambient temperature is less than 50°F, the field cured cylinders shall be placed in an insulated box.

The concrete repair area shall be cured up until the time of opening to traffic. All exposed surfaces, including vertical surfaces, shall be cured immediately after finishing operations have been completed.

Curing and protection shall be in accordance with Subsection 501.03.20. White pigmented curing compound shall be used and the sprayer shall be equipped with a container having a capacity of not less than five gallons and maintain a constant pressure by mechanical means. Curing time shall be continued until the concrete has attained the required compressive strength as evidenced by test specimens.

- (f) Concrete Saw Cuts. The saw cut shall be at the locations and depth shown on the plans.
- (g) Contraction Joint Assembly. Contraction joint assemblies shall be installed as per the details shown in the plans.
- (h) Concrete Placement. Limitations on placing continuously reinforced concrete pavement are set forth in the following schedule:

**CONCRETE PAVING SCHEDULE
DURING DAYTIME HOURS**

<u>Predicted High Temperature</u>	<u>Hours of Daytime Placement</u>
Below 70°F	Daylight hours
70° - 84°F	12:00 Noon to Sundown
85° - 89°F	1:30 PM to Sundown
90°F & Above	3:00 PM to Sundown

Note: The National Weather Service's predicted high temperature for the day shall govern. Unless lighting provisions have been made for nighttime work, sufficient time must be allowed for the finishing operation prior to sundown but no less than 30 minutes will be permitted.

**CONCRETE PAVING SCHEDULE
DURING NIGHTTIME HOURS**

During nighttime operations, concrete pours may be made anytime between sundown and sunrise without regard to predicted high temperatures.

503.03.7--Opening to Traffic. Upon approval of the Engineer, the traffic lane shall be opened within 72 hours and may be opened when a 2500 psi compressive strength is obtained as verified by cylinder break. Side forms shall be removed and the shoulder repaired with hot mix asphalt pavement, and the area cleared of equipment and waste materials prior to opening to traffic.

The sampling and testing frequency for concrete test cylinders shall be at least two cylinders per day per section of lane for which an individual lane closure is effected and concrete pavement is replaced.

The Contractor must make arrangements to have the concrete compressive cylinders tested by an acceptable commercial laboratory. Results from laboratory tests may be accepted verbally to expedite the opening of traffic to a section of closed roadway, but the Contractor must furnish the Engineer with certified test reports within three days. Any misrepresentation of test cylinders which allows traffic to be opened in areas that did not meet minimum requirements will result in the Contractor removing and replacing the repair(s) represented by the cylinder at no additional cost to the State.

503.04--Method of Measurement. Replacement of the concrete pavement will be measured for payment by the square yard complete in place. Saw cuts will be measured for payment by the linear foot when a pay item is included in the contract proposal. Concrete for base repair will be measured by the cubic yard

complete in place. Smooth dowel bars and tie bars will be measured per each complete in place.

No separate measurement will be made for reinforcing steel, wire mesh, longitudinal joints, polyethylene sheeting and hot bituminous pavement for repair of shoulders and maintenance of traffic items required.

The plans may also provide for welding of the reinforcing steel as an optional method available to the Contractor. This method reduces the width of the lap area from 20 inches to eight inches which will reduce the size of the repair areas. If the Contractor elects to use the optional method, the subsequent reduction in plan quantities will not be justification for adjustment of contract unit prices as provided in Subsection 104.02.

503.05--Basis of Payment. The accepted quantities of saw cuts, concrete for base repairs, smooth dowel bars, tie bars, and concrete pavement will be paid for at the contract unit prices which shall be full compensation for completing the work, furnishing all labor, equipment, tools, materials, and bituminous plant mix required for shoulder repair. Removal and disposal of pavement and base materials shall be made under appropriate items under Section 202.

The price for each item of work shall include the cost of continuous maintenance of traffic and protective services as required by the Department's Traffic Control Plan. This shall include all required individual traffic control devices.

Payment will be made under:

- 503-A: ____ " and Variable Type Concrete Pavement,
 Type Finish - per square yard
- 503-B: Saw Cut, Longitudinal Joints - per linear foot
- 503-C: Saw Cut, ____ " - per linear foot
- 503-D: Concrete for Base Repair - per cubic yard
- 503-E: Tie Bars, No. ____ Deformed, Drilled and Epoxied
 or Grouted - per each
- 503-F: ____ " Smooth Dowel Bars, Drilled and Epoxied
 or Grouted - per each

SECTION 508 - SILICONE SEALED JOINTS

508.01--Description. This work shall consist of cleaning and sealing joints in

accordance with the plans and these specifications.

508.02--Materials. The silicone sealant material used in this construction shall meet the requirements of Subsection 707.02.1.4. The backer rod shall meet the requirements of Subsection 707.02.1.5.

508.03--Construction Requirements.

508.03.1--Cleaning. Joints shall be clean, dry and frost free when the sealant is applied. Formed joints shall be thoroughly cleaned to remove all form release agents, curing compound residue, laitance, or any other foreign materials. All joints shall be thoroughly cleaned by sandblasting each face separately to the depth of the sealer and backer rod. The cleaning operation of existing joints shall ensure that the concrete joint surfaces which are to receive the new joint sealant and backer rod are free of all debris, discoloration and stain; as well as any and all other forms of contamination. If a clean exposed concrete surface cannot be obtained by sandblasting, the joints shall be refaced with a power driven concrete saw with diamond and/or abrasive blades. The refaced joints shall be washed and sandblasted as set forth above. Immediately prior to installation of the backer rod, the joints shall be cleaned with compressed air which is free of moisture and oil. Wiping fingers on cleaned surface of joints shall not show evidence of dust. The joints shall be completely free of sand, oil and moisture.

Material in expansion joints shall be removed to the required depth with a power saw and/or router in such a manner as not to damage the expansion material which is to remain in place.

508.03.2--Installing Backup Material. When shown as a requirement of the contract and after the final cleaning, a resilient rod type backup material shall be installed with a positioning device to ensure conformity with the dimensions shown on the plans. The rod shall be compatible with the sealant and no bond or reaction shall occur between the rod and the sealant. Unless otherwise designated, the rod diameter shall be one-eighth of an inch (1/8") greater than the joint width.

508.03.3--Installing Silicone Sealant. The installation of the sealant is to be performed as soon after placing the backer rod as reasonably possible to ensure that joints are still clean and dry. In the event a joint does become contaminated, damp, or wet, the backer rod is to be removed and the joint cleaned and dried with a new backer rod reinstalled prior to placing the sealant. The ambient temperature at time of placement must be 40°F or higher. The sealant shall be applied by pumping only. The pump shall be of sufficient capacity to deliver the necessary volume of material to completely fill the joint to the specified width and height of sealant in one pass. The nozzle shall be of sufficient size and shape to introduce the sealant inside the joint with sufficient pressure to prevent voids occurring in the sealant and force the sealant to make contact with the joint faces.

This is especially critical in large joints. The sealant, if not of the self leveling type, shall be tooled to provide the specified recess depth, thickness and shape as shown on the plans. Sufficient force or pressure shall be applied to the sealant in this tooling operation to force the sealant against the joint faces to ensure satisfactory wetting and bonding. The sealant shall be placed to reasonably close conformity with dimensions and shape shown on the plans. Any unreasonable deviation will be cause for rejection and necessary corrective action will be made by the Contractor.

508.03.4--Cleaning Pavement. After a joint has been sealed, all surplus sealant on the pavement shall be promptly removed.

508.03.5--Opening to Traffic. Traffic shall not be permitted over the sealed joints until the sealant is tack free.

508.04--Method of Measurement. Silicone sealed joints will be measured by the linear foot.

508.05--Basis of Payment. Silicone sealed joints will be paid for at the contract unit price per linear foot, which shall be full compensation for satisfactorily completing the work.

The price for this work shall include the cost of continuous maintenance of traffic and protective services as required by the Department's Traffic Control Plan. This shall include all required individual traffic control devices.

Payment will be made under:

508-A: Silicone Sealed Joints - per linear foot

SECTION 510 - REPAIR OF CONCRETE PAVEMENT

510.01--Description. This work consists of surface preparation, including cleaning, and placement of polymer concrete in spalled areas of concrete pavement, or other areas directed by the Engineer, in accordance with these specifications and in reasonably close conformity with the lines and grades of the existing pavement.

510.02--Materials. The polymer concrete shall be one of the approved materials listed in the MDOT's "Approved Sources of Materials" under the List of Approved Rapid Setting Commercial Grouts and Patching Compounds for use in the repair of punch-outs (spall repairs) in concrete pavements.

510.03--Construction Requirements.

510.03.1--Surface Preparation. All spall areas one inch in diameter or larger shall be cleaned and prepared for receiving the polymer concrete. The Contractor shall remove all loose, cracked or deteriorated concrete from the spalled areas using a mason or shop hammer and if necessary, a jack hammer not larger than 20 pounds. Spalled areas shall first be sand blasted, or other method approved by the Engineer, until concrete exhibits an obvious color change, and then air blasted to remove all loose debris.

510-03.2--Manufacturing and Placing of Polymer Concrete. Spalled areas must be completely dry prior to priming and placement of polymer concrete. Priming resin shall be mixed according to the manufacturer's published recommendations. The entire area of spalls plus an additional two inches around the circumference of the area shall be primed using a brush. Priming resin may be allowed to gel prior to placing resin/aggregate. The resin shall be mixed with the aggregate in accordance with the manufacturer's recommendation until the aggregate is thoroughly wetted with the resin.

The Contractor shall first fill, tamp, trowel and screed the spalled area parallel to the centerline of the roadway, then apply a surface coat of dry graded aggregate and tamp into wetted aggregate to provide skid resistance.

The polymer concrete shall be allowed to cure for two (2) hours prior to opening the area to traffic.

510.04--Method of Measurement. Graded aggregate and resin used in polymer concrete pavement repair of spalled areas will be measured by the cubic foot of aggregate and by the gallon for resin. Catalyst will not be measured for separate payment.

510.05--Basis of Payment. Graded aggregate and resin, measured as provided above, will be paid for at the contract unit price per cubic foot of aggregate and gallon of resin, which price shall be full compensation for all surface preparation, cleaning, priming, placing of polymer concrete, disposal of all surplus material; and for all materials, equipment, tools, labor and incidentals necessary to complete the work.

Payment will be made under:

510-A: Graded Aggregate - per cubic foot

510-B: Resin - per gallon

SECTION 511 - PREROLLING EXISTING PAVEMENT

511.01--Description. This work consists of prerolling existing pavement to

determine construction procedures required under other provisions of the contract.

511.02--Blank.

511.03--Construction Requirements.

511.03.1--Equipment. The roller shall consist of a single-axle trailer-type roller or a loaded truck having a single rear axle. The axle shall be loaded to a gross weight equal to or greater than the maximum legal load for a tandem axle on the highway on which the project is located but not to exceed 25 tons, and the Contractor shall provide the means necessary for the Engineer to determine that these weight requirements are being met.

The wheels shall be equipped with pneumatic tires capable of being inflated to a minimum inflation pressure of 100 psi. Tires may contain liquid if the Contractor so desires. The Contractor shall provide the Engineer with verification of gross axle weight and tire pressures.

If a trailer type roller is used, it shall be towed by a rubber tired prime mover capable of maintaining a speed of two miles per hour. The prime mover with roller attached shall be capable of executing a 180° turn within a width of 30 feet.

511.03.2--Protection. Rolling shall be conducted so as to avoid damage to existing structures and features designated to remain. Damage to such structures and features shall be repaired or the items replaced, in kind, at no additional cost to the State. The loaded roller shall not encroach upon bridge end pavement or, in the absence of bridge end pavement, within 20 feet, or greater distance when directed, of bridge abutments except under specific authority granted to cross a bridge.

Live loadings on any bridge shall not exceed the statutory loading permitted on the bridge except the Department may consider an overload permit for individual cases. All pertinent information, including proposed frequency and size of loadings and type and exact location of bridges shall be furnished the Department in order that a comprehensive study may be made.

Loading limits on bridges under the jurisdiction of agencies other than the Department are set by the agencies, independently of statutory limits and the Department.

511.03.3--Construction Methods. The sequence of rolling and the operating speed of the roller shall meet the approval of the Engineer. A roller coverage is defined as a single pass over a single traffic lane.

Generally, one coverage will be sufficient to determine slabs requiring treatment.

Extra coverages may be required when necessary to confirm slabs to be treated.

It is the intent of this specification to hold the rolling operation to a minimum, and rolling coverages considered unnecessary by the Engineer are to be omitted.

Prerolling may begin as early as 4:00 A.M. and continue as long as the surface temperature of the pavement remains below 85°F.

The above work shall be included and correlated with the general sequence of operations set out in Subsection 403.03.5.2.

511.04--Method of Measurement. Prerolling will be measured by the square yard. The area of prerolling will be computed by using the horizontal length along the centerline of the roadway and the width, unless otherwise specified, of the concrete pavement in or under the traffic lane being prerolled.

Only areas designated by the Engineer to be rolled will be measured for payment. Test rolling as provided in Section 412 will not be included in measurement for prerolling.

511.05--Basis of Payment. Prerolling will be paid for at the contract unit price per square yard, which shall be full compensation for completing the work.

Payment will be made under:

511-A: Prerolling - per square yard

SECTION 512 - PRESSURE GROUTING CONCRETE PAVEMENT

512.01--Description. This work consists of locating unstable concrete pavement, drilling of holes and the pumping of a slurry type grout mixture to stabilize and underseal the pavement. The grout mixture shall form a hard and insoluble mass that will effectively fill the voids. Pavement that remains unstable after an initial undersealing and stabilizing attempt shall be re-grouted as directed by the Engineer.

When a hot mix asphalt overlay is required, it shall be the Contractor's responsibility to schedule operations in such a manner that the first course of overlay will be placed at the earliest practicable time and no later than fourteen days after the pavement has been stabilized.

When designated on the plans, this work shall also consist of drilling holes in the shoulder adjacent to cracks at the edge of the pavement and the pumping of a slurry type grout mixture to fill the cracks to the surface of the cement treated shoulder. Unless otherwise specified, Type 1 grout shall be used. If in the

Engineer's opinion, the type of grout being used proves to be unsatisfactory, the Contractor shall switch to a Type 5 grout at no change in contract price.

512.02--Materials. shall meet the follows requirements:

Materials used in the work shall meet the requirements specified in the following sections or subsections:

Portland Cement Types I or III	701
Calcium Chloride, Type I	714.02*
Fly Ash, Class C or F	714.05
Water	714.01.1 and 714.01.2
Fine Aggregate	703.18**
Limestone Dust	512.02.1

- * The Materials Engineer may approve other commercially available accelerators which may be substituted for calcium chloride.
- ** Fine aggregate shall meet the requirements of Subsection 703.18 except that mortar making properties are not required.

512.02.1--Limestone Dust. The source of the material shall be approved by the Engineer and meet the following gradation requirements:

SIEVE	PERCENT PASSING
No. 30	95-100
No. 200	20-100

512.02.2--Proportioning Grout Mixture. The bid item will designate the type or types of grout mixture which shall consist of proportions listed in the table below. The mixing water shall be that quantity which will produce a grout of such consistency that the time of efflux from the flow cone will be a minimum of 16 seconds and a maximum of 22 seconds. Upon approval of the Engineer, a wetting agent may be added to the water to reduce surface tension and increase flowability of the grout mixture.

The consistency will be determined by Mississippi Test Method MT-56. Cement, fly ash, limestone dust, and/or fine aggregate may be added in the proper proportions to a mixed batch to produce the required consistency provided the cement factor is not reduced to less than specified.

**GROUT MIXTURES
PERCENT BY WEIGHT OF DRY MATERIALS**

DRY MATERIALS	TYPES					
	1	2	3	4	5	6
Cement	25	25	25	25	30	25
Limestone Dust	25	75	50			
Fly Ash	25		25	70		
Fine Sand	50	50				75
Calcium Chloride	*	*	*	*	*	
* As prescribed in Subsection 512.03.1						

It shall be the Contractor's responsibility to have the grout mixture in its final position within one hour after adding the mixing water.

512.03--Construction Requirements.

512.03.1--Weather Limitations. Pressure grouting shall not be performed when the subgrade contains an abnormal amount of moisture as evidenced by standing water on the pavement or in joints or cracks. The air temperature shall be above 40°F in the shade or 35°F and rising before starting any grout pumping operation.

The following temperature ranges shall control the quantity of calcium chloride to be included in the grout mixture:

ATMOSPHERIC TEMPERATURE	PERCENT CALCIUM CHLORIDE BY WEIGHT OF CEMENT
35 - 55°F	5
56 - 69°F	4
70 - 79°F	3
80 - 89°F	2
90°F and above	1

The quantity shall be as prescribed unless otherwise directed by the Engineer. Upon approval of the Engineer, the calcium chloride may be reduced in quantity or eliminated as required with the use of Class "C" fly ash. The calcium chloride shall be thoroughly pre-mixed in the mixing water.

512.03.2--Equipment. The equipment shall be that customarily used in pressure grouting of earthen embankments or mud-jacking of concrete pavement. It shall consist of no less than the following:

- (a) Air compressors of sufficient capacity for operating pneumatic equipment.
- (b) Pneumatic equipment with a drill size that is compatible with the size of

the pump discharge nozzle. The equipment shall be in satisfactory operating condition and operated in such a manner as to prevent unnecessary damage to the pavement.

- (c) Equipment for accurately measuring and proportioning by volume or weight the component materials of the grout.
- (d) A mixer capable of thoroughly mixing the grout in an approved manner. A batch type and concrete mixing trucks may be used for types 2 and 3 grout mixtures. A colloidal mixer must be used for Types 1, 4 and 5 grout mixtures.
- (e) A positive action pump capable of forcing grout into voids and cavities beneath the pavement. The pump shall be capable of producing a discharge pressure range of 50 to 200 pounds per square inch of the end of the discharge pipe. The pumping system shall be equipped with a pressure gauge so that any instantaneous change in pressure can be detected by the inspector.
- (f) A stop watch and flow cone conforming to the dimensions and other requirements set out in the Department's SOP for Mississippi Test Method: MT 56.
- (g) Testing equipment shall consist of a tandem axle truck with dual wheels and the rear axles shall be loaded to 50 kips evenly distributed. The measuring equipment shall consist of no less than two gauges mounted on a measuring device that is capable of detecting movement of 0.001 of an inch. A driver and sufficient personnel to assist in preliminary testing, when required by the contract, and stability testing.
- (h) Equipment to measure pavement lift shall consist of no less than four gauges mounted on a measuring device or devices that is capable of detecting movement on each side of a joint or crack and the adjoining shoulder simultaneously. The equipment shall make such measurements to 0.001 of an inch.

512.03.3--Testing.

512.03.3.1--General. When testing is required, it is intended to locate all pavement having a deflection exceeding 0.030 of an inch. Testing may begin as early as 4:00 A.M. and continue as long as the surface temperature of the pavement remains below 85°F.

512.03.3.2--Preliminary Testing by the Department. When the pavement has been tested and marked by the Department, preliminary testing will not be required by the Contractor.

512.03.3.3--Preliminary Testing by the Contractor. When the contract includes a unit bid price for testing and it has not been performed by the Department, all of the project or designated areas shall be tested by the Contractor. Testing shall be performed as follows:

One set of gauges will be positioned on each side of a joint or crack near the pavement edge. The gauges will be zeroed with no load on either side of the joint or crack. The test truck will then be moved into position and stopped with the center of the nearest test axle about one foot from the joint or crack and the outside test wheel about one foot from the pavement edge. The gauges will be read and the test truck will then be moved across the joint or crack to a similar position for a second reading of the gauges. This operation will be repeated for each joint or crack to be tested. The inspector will be responsible for reading the gauges and subsequent recording. All locations with movement of more than 0.030 of an inch will require pressure grouting.

When testing shoulders, gauge positioning and testing shall be the same as indicated above for roadway pavement. The Engineer may adjust the position of the gauges to meet field conditions.

512.03.3.4--Stability Testing. After the designated areas have been pressure grouted in accordance with these specifications, they shall be retested in accordance with Subsection 512.03.3.3 when the contract includes a unit bid price for testing.

Any undersealed pavement with movement of 0.030 of an inch or more shall be re-grouted and tested as directed.

Any pavement which continues to show movement in excess of that specified after two properly performed groutings may be accepted, or the slab may be removed and replaced as directed by the Engineer.

512.03.4--Drilling Holes. The hole pattern and pumping sequence shown on the plans shall be used, except when modified to use drilling holes made from previous undersealing work. The Contractor may alter the hole pattern with the Engineer's approval. However, only the actual number of holes drilled will be measured for payment.

The holes shall be of a size and shape that best provide a positive seal for the pumping nozzle. The holes shall be drilled to a depth of approximately eight inches below the bottom of the concrete for the initial undersealing unless the Engineer approves an alternate depth. The number, depth and location of holes for undersealing after the initial operation shall be approved by the Engineer.

When pressure grouting cracks located in the shoulders at the edge of the pavement, the holes in the shoulders shall be located as shown on the plans or as

directed by the Engineer. These holes are to be drilled below the treated base.

512.03.5--Cleaning Holes. Prior to pumping the grout, compressed air shall be used to remove debris and to help provide a passage for the grout.

512.03.6--Pumping the Grout. The nozzle of the discharge hose shall be secured in the hole in a manner that provides a seal adequate to maintain the grout pressure underneath the slab. The nozzle end shall not extend below the bottom of the concrete. Pumping will continue until a clear flow of grout protrudes from an adjacent hole, joint or crack, or until the pavement begins to lift. This procedure will be repeated in other holes until all voids are supposedly filled. Plugging of holes during grouting operations will not be permitted.

Additional evidence that grouting should cease is a rapid rise of the pavement, or a rise of the adjacent shoulder. A minimum lifting of the pavement will generally be required to move grout into the cavities and voids, however, the lifting shall not exceed 0.050 of an inch. Movement of the pavement and adjacent shoulder will be monitored by the Contractor with equipment as required by Subsection 512.03.2(h). Care shall be taken not to crack the pavement by differential lifting. During pumping, very close attention shall be given to the lift measuring device to prevent excessive pumping pressures.

Moderate to major pavement cracks or pavement broken during the pumping operation due to the Contractor's negligence will be repaired or removed and replaced at the Contractor's expense.

512.03.7--Clean Up and Opening to Traffic. Deposits of mud and/or grout on the pavement or shoulders shall be removed and the surface cleaned before traffic is permitted on the section. Other debris, bags, spillage, etc., shall be removed from the right-of-way each day.

Traffic shall not use the undersealed pavement for at least three hours after grouting. Grouting operations shall cease at least three hours before sundown or earlier as necessary to permit the grout to harden at least three hours.

512.03.8--Permanently Sealing Holes. When pavement is not to be overlaid all grout shall be removed from the holes to the bottom surface of the concrete pavement and filled with a stiff sand-cement mixture or an approved quick setting patching material. Filled holes that ravel out or become damaged shall be repaired. All holes from previous undersealing work that were used by the Contractor shall also be similarly repaired at no cost to the Department.

512.03.9--Stability Tests. The test shall not be conducted until the undersealed pavement has been open to traffic for at least twelve hours. These tests shall be conducted in accordance with Subsection 512.03.3.4. Based upon these test results the pavement will be accepted or designated for further undersealing or

replaced as directed by the Engineer.

512.04--Method of Measurement. Holes drilled at locations and to the depths shown on the plans or directed by the Engineer will be measured per each. Additional holes required for subsequent undersealing operations will be measured per each.

Portland Cement incorporated into the grout mixture will be measured by the pound.

Calcium chloride incorporated into the completed work in accordance with the provisions of the contract will be measured by the pound.

When required, preliminary testing in accordance with Subsection 512.03.3.3 will be measured by the mile, linear horizontal measure, for each lane of roadway.

Stability testing at each joint or crack in accordance with Subsection 512.03.3.4 will be measured per each lane joint or each lane crack, up to a maximum of three tests.

512.05--Basis of Payment. Holes will be paid for at the contract unit price per each, which price shall be full compensation for drilling and sealing the hole.

The portland cement and calcium chloride incorporated into the grout mixture will be paid for at the contract unit price per pound, which price shall be full compensation for furnishing materials to be incorporated into the specified type of grout mixture, for all hauling, mixing, pumping and clean-up required to stabilize the pavement.

Preliminary testing will be paid for at the contract unit price per mile, which price shall be full compensation for furnishing all testing equipment, the load test truck and necessary personnel to assist in the testing.

Stability testing will be paid for at the contract unit price per each test and shall be full compensation for furnishing all testing equipment, the load test truck and necessary personnel to assist in the testing.

Cost for maintenance of traffic and individual traffic control devices as required by the Department's Traffic Control Plan shall be included in the unit prices for pressure grouting and will not be measured for separate payment under the provisions of Sections 618 and 619.

Payment will be made under:

512-A: Holes * - per each

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512-B: Portland Cement Pressure Grout Slurry, Type _____

512-C: Calcium Chloride

512-D: Preliminary Testing

512-E: Stability Testing, Lane Joint

512-F: Stability Testing, Lane Crack

* Indicate "In Shoulders" when holes are required in shoulders

Section 512

- per pound

- per pound

- per mile

- per each

- per each